The Effect of Economic Sanctions on the Mortality of Iraqi Children Prior to the 1991 Persian Gulf War

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A B S T R A C T

Objectives. This study examined the effect of sanctions on mortality among Iraqi children.

Methods. The effects of economic sanctions on health are not well known. Past studies on the effect of economic sanctions on mortality have suffered from unreliable data sources and the collinearity of sanctions with other negative economic events. We overcame these weaknesses by using individual child records from a retrospective survey of mothers conducted after the 1991 Persian Gulf War to examine the effect of sanctions on mortality among Iraqi children. Multivariate proportional hazards analysis was used to assess the effect of economic sanctions prior to war (from August through December 1990).

Results. We found that after controlling for child and maternal characteristics, when economic sanctions were entered into the proportional hazards equation, the risk of dying increased dramatically. This increase was highly significant statistically.

Conclusions. Innovative application of robust epidemiologic research tools can contribute to assessments of health and well-being even under the methodological and practical constraints of comprehensive economic sanctions, but more research is needed. (*Am J Public Health.* 2000;90:546–552)

Economic sanctions are a tool used to pressure a country into changing its conduct. Sanctions are defined as "punitive economic actions, usually the refusal to sell goods between one state or multi-state body and another."[1(p455)] Multistate sanctions, such as those imposed by the United Nations (UN), were infrequently applied before the end of the Cold War in 1990.[2–4] However, the prevalence of multinational sanctions is increasing (as evidenced by the collective international sanctions imposed against Iraq, the former Yugoslavia republics, and Haiti), and such sanctions are likely to become even more common.[5]

Sanctions are widely considered to be a less violent alternative to war. When considering whether to wage war on Iraq, Admiral William Crowe, a former chair of the Joint Chiefs of Staff, said: "Using economic pressure may prove protracted, but if it could avoid hostilities or casualties, those also are highly desirable ends."[6(p236)] Also weighing sanctions against war, Elliott and colleagues wrote, "The key question is whether the price of patience would be higher than the economic and human costs of going to war soon."[7(p259)]

Sanctioning powers impose sanctions at little direct cost and do so usually either to avoid warfare or to build political support for subsequent military intervention. But many policymakers have reservations about using sanctions, which Boutros-Gali called "a blunt instrument which affects the most vulnerable in a society."[8]

To date, the effect of sanctions on the health of civilians is an open empirical question. The literature on the effect of sanctions mainly focuses on the speed, direction, and causes of policy change related to the imposition of sanctions. Aid and development organizations have reported that economic sanctions have a negative effect on the health and well-being of affected civilian populations.[9–11] However, these observations are not well documented. Documentation is important because a more precise understanding of the effects of economic sanctions will allow the development of more realistic policies.[12] The UN has called for an assessment of the potential effect of planned sanctions and the need for actions that would minimize sanctions' effect on children.[8] If international diplomacy is to effectively use sanctions as an instrument, then their intended *and* unintended effects must be understood.

In this article, we first present background information on sanctions imposed on Iraq prior to the 1991 Persian Gulf War. Then, we discuss the data source we used and present evidence on child mortality during the sanction period by examining survival curves and using proportional hazards analysis. Our analysis shows that during the sanctions period, the probability of death among children increased substantially. We conclude by discussing our results, addressing whether sanctions can be designed differently so as to minimize harm to civilians, and outlining further lines of inquiry.

Background

"Determined to bring the invasion and occupation of Kuwait by Iraq to an end and to restore the sovereignty, independence, and territorial integrity of Kuwait,"[13(p138)] the UN in August 1990 imposed economic sanctions on Iraq, blocking virtually all commercial imports and exports, freezing Iraqi funds, and banning travel on Iraqi transport. The sanctions

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did not include "supplies intended strictly for medical purposes, and, in humanitarian circumstances, foodstuffs."[13(p139)] (Resolution 665 asserted that the UN would monitor the situation regarding food.[13(p144)]) In practice, the sanctions exempted only medicines, and these only prior to the Gulf War, which began in January 1991. Food importation was permitted again starting in March 1991. In September 1992, the UN passed a resolution permitting the use of frozen Iraqi funds to purchase some humanitarian goods, and this resolution was first implemented in December 1996. (The UN empowered itself to purchase and supervise the distribution of these goods, conditions that the Iraqi government found onerous and did not accept, which delayed the implementation of the resolution.)

The sanctions imposed on Iraq were particularly swift and severe. In December 1990, Zbigniew Brzezinski testified that

> [b]y some calculations, about ninety-seven percent of Iraq's income and ninety percent of its imports have been cut off, and the shutdown of the equivalent of forty-three percent of Iraq's and Kuwait's GNP has already taken place. This is prompting the progressive attrition of the country's economy and warmaking capabilities. Extensive rationing is a grim social reality.[14(p252)]

The economic effects of the sanctions appeared almost immediately.

Four interrelated factors make determining the effect of sanctions on the health status of civilians difficult. First, other social disruptions that affect the country's ability to document mortality and morbidity often accompany sanctions. Sanctions are imposed for reasons that may involve, for example, a change in government or a military action. These activities could disrupt the normal functioning of the country and distract from the ordinary public health efforts and the normal operation of a vital registration system, even without the added complication of sanctions.

Second, the effect on health may be neither direct nor immediate. Sanctions directly affect trade, aid, economic activity, and access to key goods.[3,15] These factors affect health only indirectly, as they directly affect the ability of the government to import essential goods and the purchasing power of households. Goods with obvious potential impact on health include food, medicines, transportation, water, waste disposal, chlorine for water purification, soap, and fuel for heating and cooking. Morbidity and mortality can be expected to rise only when effective access to such goods falls below that required to maintain subsistence levels.

Third, the chain of events from distal to proximate causes for increased mortality as a result of sanctions is not well known. The reported effects of economic sanctions include low birthweight and micronutrient deficiencies caused by worsening diet, diarrheal diseases related to deteriorating sanitation and limited water quantity and quality, infectious disease epidemics caused by crowding and unplanned human migration, and decreasing access to medical care caused by shortages of medicine and transportation.[10,16] Such resource shortages will have a differential effect in societies with varying educational levels, cultures, and resource distribution patterns.

Finally, sanctions often are imposed on less developed countries.[2] These countries often have weak health systems with incomplete or unreliable health services and poor demographic data and vital registration systems. Therefore, target countries have difficulty documenting the health effects.

The effects of sanctions on a population may be similar to the effects of other events that disrupt the economic and social environments. Throughout the 20th century, wars have had an increased effect on noncombatant populations as a result of economic disruption, destruction of public health infrastructure, population movements, loss of access to medical care, and shortages of food.[17–25] Economic declines in some developing countries in the 1980s were expected to result in demonstrable increases in infant mortality. Although homelessness and poverty increased in Latin America, resource shortages did not become severe enough to disrupt long-term trends toward declining infant and child mortality.[26,27] Damrosch[5] hypothesized that sanctions will have similar, but less severe, effects on civilian populations in comparison with warfare.

Few studies have examined the effect of sanctions on the health of civilians. Berggren et al.[11] examined the health effects of sanctions in Haiti by comparing presanction with postsanction mortality levels among young children in one region. They reported a rise in the mortality rate among children aged 1 to 4 years from 10 per 1000 to 18 per 1000 and a decline in the infant mortality rate from 48 to 39 from 1991 to 1992. Berggren et al.[11] concluded that the child mortality rate increased because of the sanctions. However, the study did not identify why sanctions would decrease infant mortality or if that small area and short time were representative of the entire country during the 1991 through 1994 embargo.

While conducting fieldwork on the effect of sanctions on Iraq, E. Hoskins (oral communication, July 1994) found that food shortages began as soon as sanctions were implemented. To relieve food shortages, the Iraqi government instituted rationing in September 1990. Shortfalls in production and importation became much worse following the war, resulting in a 25-fold increase in prices for nonrationed foods. Water, sewage, electric, and communications systems were destroyed during the war, and the sanctions presented an additional hurdle to their repair. Reported typhoid cases increased 5-fold, the proportion of low-birthweight babies increased from 4% to 17% of all births, and measles and polio cases more than doubled. Shortages of key medical products, including insulin, resulted in increased chronic disease mortality. Because Hoskins conducted his research after the 1991 Persian Gulf War, his study could not separate out the effects of sanctions from the effect of war-related destruction.

Garfield et al.[1] collected data on decreased importation of medical goods and increased cause-specific mortality in Cuba following the 1992 reimposition of a ban on third-country trade from the United States to Cuba. They found a rise in low birthweights, a small increase in mortality from infectious diseases among young children, and a 10% increase in mortality among those older than 65 years, primarily due to the complications of chronic diseases.

During the sanction period in the Republic of Yugoslavia, deaths overall were reported to have increased 10% and hospital mortality increased 30%.[28] Other studies in South Africa and Nicaragua noted no rise in mortality that could be associated with sanctions per se.[1]

Sanctions can limit access to necessary goods in 2 ways. One way is by decreasing a household's entitlement to necessary goods.[29] During an embargo, a country is deprived of trade from at least 1 other country, depending on whether the sanctions are bilateral or multilateral. The magnitude of the sanctions' effect might depend on the importance of the blocked trade relationships to the sanctioned country's economy. An imposing country could have a large but easily substitutable trade relationship with a targeted country or, alternatively, a minimal but nonsubstitutable or not easily substitutable trade relationship.

In either case, the entitlement to goods included in the sanctions would decrease in the targeted country, by an increase in the cost of goods (because of a shortage of them), a decrease in wages (because of a decreased demand for labor or primary resources), or a combination of these factors. The degree of hoarding of goods affects the price of goods: If the population hoards goods at the threat of or imposition of sanctions, prices could rise immediately. If the population does not hoard, then prices would not necessarily rise until actual shortages reach the marketplace. Individuals who

require a good included in the sanctions to survive will continue to purchase the good even at extremely high prices for as long as their resources will allow. However, individuals would try to stretch the good, which could compromise health.

Baldwin[30] discussed another mechanism by which sanctions limit the resources available to purchase items necessary for survival. He noted that even if a country has the capability to internally produce the sanctioned items, internal production may not be as efficient as purchasing the goods abroad. Therefore, we expect that by adding this inefficiency to the sanctioned country's economy, sanctions act to decrease the country's overall level of economic well-being. Reuther[31] and Al-Samarrai[32] suggested that sanctions imposed on Iraq provoked hyperinflation.

Overall, we anticipated that sanctions would have effects similar to those of other events that impose severe stress on a country's economic system, such as war and postwar periods, economic restructuring, famine, or political upheaval.

Methods

Data Collection

To assess the health conditions of Iraqi children, the Harvard-based International Study Team (also known as the Harvard Study Team) conducted a community-based survey from August 25, 1991, through September 5, 1991 (for details, see articles by the International Study Team[17,33]; also International Study Team, unpublished data, April 1992). The International Study Team conducted interviews among 271 randomly selected clusters of 25 to 30 homes in all of Iraq's provinces. Interviewers collected data from mothers aged 15 to 49 years on each child born since January 1985. The following information was collected on 16 172 Iraqi children (15 359 living children, 798 dead children, and 15 children with unusable information): date of birth, whether the child was living at the time of the survey, date and cause of death (if applicable), whether the child had diarrhea at the time of the survey, mother's education, mother's age at the time of the survey, parity, and location of residence.

The International Study Team[17] found a baseline infant mortality rate in Iraq of 32.5 per 1000 live births for 1985 through 1990, which increased to an estimated 93 per 1000 for the postwar period (March through August 1991). In cases in which the exact date of death or birth was not known, the International Study Team recorded vital events on the first of the month (see Table 1). Approximately one fifth of births and three fifths of deaths were reported to have occurred on the first of the month; thus, the data set constrains us to examining whole month periods.

The International Study Team's infant mortality rate estimate of 32.5 is lower than estimates derived from the Gulf Child Health Survey[34] conducted in Iraq in 1989 and the 1990 Iraq Immunization, Diarrhoeal Disease, Maternal and Childhood Mortality Survey.[35] These surveys reported an infant mortality rate during 1985 through 1990 in the low 40s. (Iraq's vital registration system was quite incomplete—by some estimates, it records only 30% of all deaths.)

Since the 1960s, mortality levels in Iraq had dropped rapidly, especially among infants and children (G. Jones, unpublished data, May 1992). According to Dr. Gareth Jones (unpublished data, May 1992) of the United Nations Children's Fund (UNICEF), throughout the 1980s infant mortality decreased rapidly in Iraq, perhaps because in 1980 the Iraqi government embarked on a campaign to reduce infant mortality by half by 1990. In 1977, Iraq's infant mortality rate was 61; by 1987, it had declined to between 36 and 42. A report on the 1990 health survey of mothers and children[35(pp45–46)] also noted the rapid drop in infant mortality in the 1980s: "Evidence from this survey as well as the findings of the Iraq NCHS [National Center for Health Statistics] of 1989 point to a strong rapid downward trend in infant and child mortality over the past fifteen years. During the 1980s, in particular, the downward trend in infant mortality has been particularly steep." In fact, the Iran–Iraq War, which in this data set affects information pertaining to January 1985 through August 1988, appears to have had no adverse effect on infant and child mortality, perhaps because fighting was localized in 1 border region, and shortages of medicines or food among Iraqi civilians were never reported. In fact, demographic surveys show that mortality levels among Iraqi children declined during the war.[36]

One reason the infant mortality rate obtained from the International Study Team's August 1991 survey might have been so low is that, in their calculations, the researchers excluded cases that had missing information.[17] The criteria used in the calculations excluded disproportionately more deaths than births, thus causing a downward bias in the International Study Team's mortality estimates, especially those from the prewar period. We cleaned the International Study Team's data by using somewhat different criteria.

Cumulative Probability of Survival Before and During Sanctions

We examined the probability of surviving by contrasting the cumulative probability of surviving in 1990 by age for 2 periods: before sanctions (January through August 1990) and during sanctions (September through December 1990). Figure 1 contrasts the cumulative survival function by means of an actuarial life-table method for these 2 periods. To obtain the cumulative survival function for each of the periods, we first calculated the number of children exposed to the risk of dying during each age interval (r_i), estimated by $r_i = n_i - (0.5 \times c_i)$, where n_i represents the number of children entering the age interval, c_i represents the number of children whose information becomes censored during the interval (status becomes unknown by the end of the interval), and age (i) is measured in months. Based on this calculation, the conditional probability of dying (conditional on entering the age interval) is $q_i = d_i/r_i$, where d_i represents the number of children who entered the age interval who died. If the conditional probability of surviving is $p_i = 1 - q_i$, then the cumulative probability of surviving until the beginning of the i^{th} interval is $P_i = p_{i-1} \times P_{i-1}$, where $P_i = 1$. (For a good reference on survival analysis, see Lee.[37]) Because the data set does not include persons born before 1985, the analysis is limited to children younger than 6 years.

The analysis represented in Figure 1 does not control for any other factors. Around each cumulative probability are dotted lines that indicate a confidence interval of 1.96 SE of the estimates. This figure shows that during sanctions, children had a lower probability of survival. Much of the difference occurs within the first year of life. Although the lines do not cross, the difference in the probability does not appear to be statistically significant.

To ensure that the difference seen during the 2 periods was not due to seasonal variation, we examined the probability of surviving during the sanction period (September through December 1990) and contrasted it with child survival exactly 1 year earlier (data not shown). Again, the lines did not cross, and we saw a clear but not statistically significant difference in the probability of survival.

Proportional Hazards Analysis

Differences in the survival rates between the presanction and sanction periods may be influenced by other factors associated with child mortality. In contrast to the life-table method, proportional hazards analysis permits one to control for factors that may influence mortality, including mother's education, region, mother's age at birth, presence of sib-

lings, and whether sanctions were imposed during the period. Proportional hazards analysis examines the hazard rate (or death rate) as a function of time and a set of covariates. The dependent variable is the time until the occurrence of events in a population. The model assumes a constant relative hazard for subgroups with a fixed set of covariates in comparison with a reference subgroup[38] and takes advantage of information on cases that are "censored" (i.e., incomplete because the person has not yet died). The reference group, which has all covariates set to zero, has an unknown hazard function.

The model for this analysis is $h(t;z)=h_0(t)e^{\beta' z}$, where $h_0(t)$ is an unknown hazard function for the reference subgroups, β is the vector of regression coefficients, and z is an individual's covariate vector. (We used the 2L procedure of the statistical software package BMDP for the computational estimations.) Proportional hazards analysis examines whether and how a covariate shifts the unknown hazard function, $h_0(t)$. Coefficients indicate that the risk (hazard) of death changes by a factor of e^{β} per unit increase in z. Positive coefficients indicate an increase in risk, whereas negative coefficients indicate a decrease.

We included fixed covariates known to affect child survival and examined whether

TABLE 1—Descriptive Statistics for Fixed Covariates That Affect Child Survival

	%	Univariate Coefficient	Exponentiated Coefficient
Sex			
Female	49.1	–0.1990*	0.8195
Male	50.9	. . .	. . .
Place of residence			
Urban	65.4	–0.3434*	0.7093
Nonurban	34.6	. . .	. . .
Siblings[a]			
At least 1 sibling present	94.9	0.2084*	2.1057
No siblings	5.1	. . .	. . .
Mother's level of formal education			
Illiterate	44.1	0.6776*	1.9691
Primary	33.8	0.4673*	1.5957
Secondary	15.9	. . .	. . .
Postsecondary	6.2	–0.3234*	0.7237
Mother's age at birth, y			
<20	11.9	0.1294	1.1382
20–24	25.6	0.0477	1.0489
25–29	24.1	. . .	. . .
30–34	19.9	–0.0905	0.9135
35–39	12.4	0.2051	1.2276
≥40	4.7	0.0805	1.0838
Day of birth			
First of month	21.2		
Day other than first	78.8		
Day of death			
First of month	62.0		
Day other than first	38.0		

Note. n = 14 118.
[a]Mean number of siblings = 0.95
*$P \leq .05$.

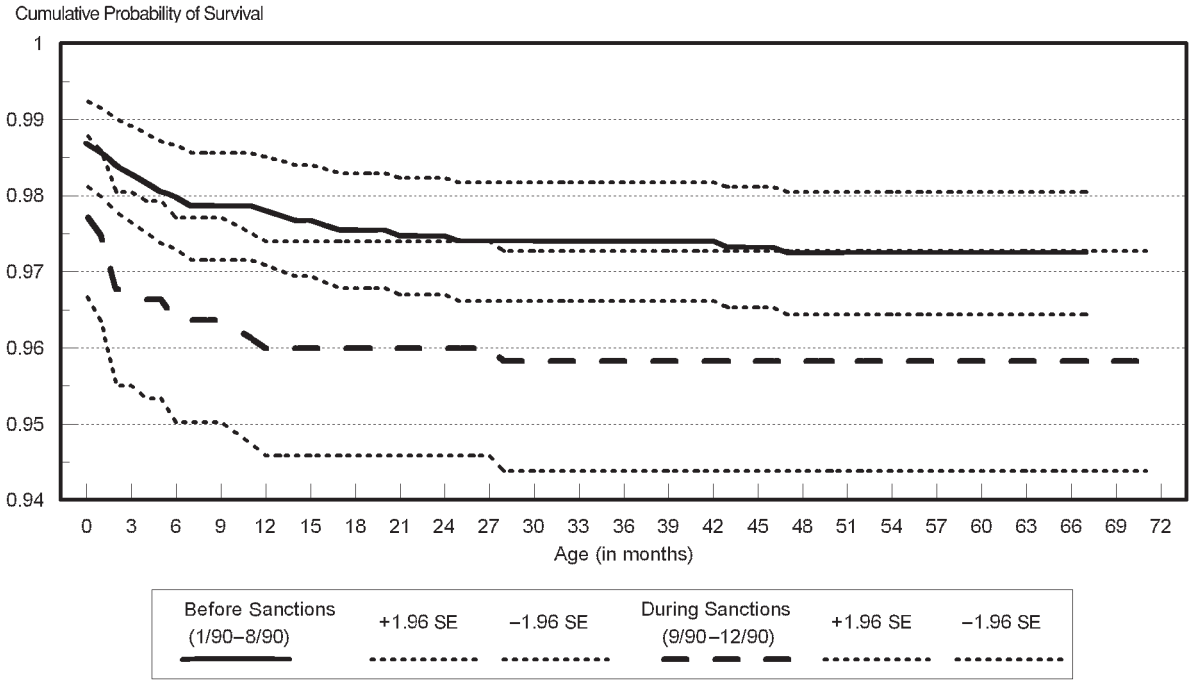

FIGURE 1—Cumulative probability of survival of Iraqi children before and during sanctions, 1990.

sanctions had an effect after controlling for these fixed covariates. This was done by creating a time-varying covariate to compare presanction and sanction periods, which is coded as 0 for the presanction period and 1 for the sanction period. Table 1 provides descriptive statistics and the coefficient obtained when the fixed covariates (sex, place of residence, presence of siblings, mother's education, mother's age at birth) were included in a univariate model. The univariate models show girls having a statistically significant survival advantage over boys; children in urban areas having a survival advantage; children with siblings having a survival disadvantage; mother's education (categorized as illiterate, primary school, secondary school, and postsecondary attainment) being positively correlated with a survival advantage; and children whose mothers at birth were either young (<20) or old (>35) having a survival disadvantage.

Although all of the above factors are fixed covariates, we created a time-varying covariate to reflect whether the period was the prewar sanction period. The variable *sanction* equals 1 if the time was during sanctions (September through December 1990) and 0 if before September 1990. We restricted the proportional hazards analysis to the period January 1, 1985, through December 31, 1990.

Table 2 shows 2 estimated multivariate models; the first includes only fixed effects, and the second adds a time-dependent covariate reflecting the presence of sanctions. All dummy variables were coded so that 1 reflects the presence of the factor and 0 reflects the absence. The table shows the coefficients, the SEs of the coefficients, and the hazard ratio (exponentiated coefficient) comparing the included and reference groups. Children with missing information were excluded from the models.

Results

The fixed covariates showing significance in the 2 equations were sex, residence in an urban area, siblings, and mother's education. The same relationships shown in the univariate equations held in the multivariate models—females, children in urban areas, children without siblings, and children of highly educated mothers showed lower hazard rates than their statistical counterparts.

Adding the sanctions variable to the second equation did not substantially change the coefficients of the fixed covariates. The coefficient for the time-dependent sanctions variable, which measures whether the probability of surviving differed between the presanction and postsanction periods after control for the other included factors, showed that during the sanctions period, children had a substantially higher hazard of dying. Compared with the presanction period, the risk of dying during the sanction period more than quadrupled. The hazard ratio of the sanctions coefficient revealed that for the reference group (nonurban males without siblings born to women in their late 20s with a high school education), the hazard of dying increased more than 4-fold during the sanctions period (the increase in the hazard can be calculated for groups of children with other demographic characteristics). The coefficient was highly statistically significant (coefficient/SE>16).

The data set was clustered at the household level. We considered the possibility that clustering may affect the size of the SEs at the household level. Specifically, there may be a correlation in the survival outcome between children in the same household. To examine whether the coefficients in the equation would remain significant once household clustering was taken into account, we calculated the design effect,[39] which is the ratio of the variance calculated when clustering is taken into account to the variance calculated when simple random sampling is assumed. The design effect ranges from 1 to the average cluster size, which in this case was the average number of children in households, 1.95. Therefore, the design effect of the variance ranged from 1 to 1.95, and that of the SE ranged from 1 to 1.4 (the square root of 1.95).

If one assumes the worst case, that perfect correlation exists within clusters, then one should multiply the SEs obtained assuming random sampling by the design effect. Multiplying each of the SEs in model 1 of Table 2 by 1.4 causes the coefficients of the variables reflecting the sex and number of siblings of the child to become statistically insignificant at the 5% level but does not change the significance of the coeffients of other variables. Multiplying the SEs of the coefficients of model 2 causes the coefficients of the variables reflecting the sex of the child, whether the mother had a primary school educational level, and

TABLE 2—Results of Proportional Hazards Analysis

	Model 1, Sanctions Omitted		Model 2, Sanctions Included	
	Coefficient (SE)	Exponentiated Coefficient	Coefficient (SE)	Exponentiated Coefficient
Female	–0.1955* (0.0786)	0.8224	–0.1933* (0.0786)	0.8242
Urban	–0.2238* (0.0807)	0.7994	–0.2238* (0.0807)	0.7995
Siblings	0.6299* (0.2837)	1.8744	1.0937* (0.2864)	2.9854
Mother's level of formal education				
Illiterate	0.6218* (0.1413)	1.8623	0.6955* (0.1414)	2.0047
Primary	0.4243* (0.1444)	1.5286	0.4603* (0.1443)	1.5846
Postsecondary	–0.2447 (0.2686)	0.7829	–0.1908 (0.2686)	0.8263
Mother's age at birth, y				
<20	0.1901 (0.1352)	1.2094	0.2869* (0.1356)	1.3323
20–24	0.1193 (0.1108)	1.1267	0.1484 (0.1109)	1.1599
30–34	–0.1809 (0.1242)	0.8345	–0.1521 (0.1242)	0.8589
35–39	0.1422 (0.1296)	1.1528	0.1470 (0.1297)	1.1583
≥40	–0.0367 (0.1973)	0.9640	–0.0712 (0.1973)	0.9312
Sanctions			1.5141* (0.0930)	4.5453

Note. n = 13 992. Omitted categories are males, nonurban residence, only children, children of mothers with secondary education, children whose mothers were aged 25 to 29 years, and for the second equation, no sanctions.
Source. Based on data from the International Study Team.
*$P \leq .05$.

whether the mother was younger than 20 years when the child was born to become statistically insignificant at the 5% level. However, even if one assumes that clustering at the household level had the worst possible effect, the coefficient of the sanctions variable remains statistically significant.

Not only does the sanctions period show a higher mortality risk than the presanctions period, but the magnitude of the sanctions coefficient exceeds that of the coefficients for any other variable. That is, the effect of sanctions on child survival exceeds the effect of sex, urban residence, presence of siblings, mother's education, and mother's age at the child's birth.

Discussion

Both the magnitude and the statistical significance of the coefficient for the sanctions variable surprised us. We had assumed that if child survival decreased during the sanctions, the decrease would be difficult to document and would appear only after a longer period of follow-up. We thus assumed that the effect of the sanctions on children would be statistically inseparable from the direct and indirect effects of the Gulf War. We further assumed that if the large database of children's records was of good quality, we would observe the common risk factors for mortality, including sex, mother's education, and early, late, and high fertility. Each of these variables showed the expected associations. Yet, during a period of 4 months, the sanctions period showed a greater influence on the hazard of dying than did any of the traditional risk factors. Among Iraqi children, the sanctions period accounted for a 4-fold rise in the hazard rate.

The time-defined variable that we call sanctions represents the 4 months immediately prior to the 1991 Persian Gulf War. Other events that occurred during that period might have confounded the association between sanctions and child mortality.[40] These include troop mobilization, which separated fathers from families and prevented income from reaching the home (although this had no effect on children's health during the Iran–Iraq War), and withholding food or medicines from the market in anticipation of impending shortages.

Many questions about sanctions' effects remain. Are the risks resulting from sanctions continuous and cumulative as shortages worsen? Our data do not permit an examination of this issue. We speculate that a society might experience an initial adjustment period during which the risk of death is inordinately high among a small minority at high risk. If the effect is discontinuous, then after an initial adjustment and because the most vulnerable have already died, the mortality rate would decrease. (The Food and Agricultural Organization of the United Nations[9] argued that sanctions continue to negatively affect the health and nutritional status of children. Evaluating the results of their research is impossible because they would not release the data on which the research was based.)

In Haiti,[11] data showed a decline in the infant mortality rate and an increase in mortality among older children (1–4 years). This outcome is supposedly the result of emergency efforts to compensate for the worsening conditions and extra efforts to protect the most vulnerable through actions such as increased feedings and a rise in the prevalence of breastfeeding. This does not seem to be the pattern in Iraq and deserves further investigation.

Whom do sanctions affect? Because of a lack of data, we cannot discern the effect on other important demographic groups, such as older children, persons of working age, women of childbearing age, and the elderly. The effect of sanctions on mortality for the other groups may be similar to what would be inferred from life-table models—the effects could be most dramatic among children and the elderly.

The finding that sanctions may negatively affect the health of civilians in the targeted country may influence the international community to extend the rule of proportionality to include sanctions. That rule states that

> [i]n conducting military operations, constant care must be taken to spare the civilian population, civilians, and civilian objects. . . . Those who plan or decide upon an attack must . . . take all feasible precautions in the choice of means and methods of attack with a view to avoiding, and in any event to minimizing, incidental loss of civilian life, injury to civilians, and damage to civilian objects; and refrain from deciding to launch any attack which may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated.[41(pp5–9)]

We should speculate about the process by which sanctions adversely affect children. Let us consider a family making purchasing decisions with a fixed set of resources. When sanctions are imposed, the prices of some goods rise (we assume that no prices fall). Although the sanctions might omit items directly necessary for survival (e.g., food and medicines), the sanctions apply to a set of items, some of which the population might still desire and for some of which there is an inelastic demand. For example, shoes may not be considered directly needed for survival, but the family may need to purchase shoes. If the price of a sanctioned item has increased dramatically, to purchase an item such as shoes the family borrows resources from other budgetary items, thinking that it will be able to survive. Hence, fewer resources remain to purchase goods necessary for survival. If data were to become available on consumer expenditures before and during sanctions, one could test this theory. However, we know of no such data set.

Because sanctions distort the economy and ultimately a family's allocation of resources, the exemption of goods for humanitarian reasons may have only a limited effect on the health of civilians. Such provisions, however, may make imposing sanctions politically more acceptable to countries considering them. (Recent negotiations between the UN and Iraq will allow Iraq to sell oil in accordance with the conditions set forth in UN Security Council Resolution Number 986. The resolution allows Iraq to sell $1 billion of oil every 3 months, with most of the proceeds going to war repatriations and UN humanitarian programs. The oil sale, however, will be on a trial basis, and Iraq must satisfy many contingencies for this modest lifting of the sanctions to continue.) Ultimately, the distinction between strategic goods (potentially used for military purposes) and civilian goods seems vague.[30] In October 1990, Michael Kinsley wrote, "There are already disputes about what constitutes 'humanitarian' food supplies under the U.N. embargo of Iraq. To what extent you bend the embargo to alleviate the suffering of innocents is a tough moral question on which reasonable people can surely differ."[42(p223)] Just as the military requires parts, gas, and tires for its trucks, so do the transporters of vaccines.

More research is needed to anticipate likely health effects, identify shortages in essential goods, and develop valid and reliable monitoring capacity to identify changes in health and well-being during sanctions. This research shows that innovative application of robust demographic and epidemiologic research tools can contribute to such assessments even under the methodological and practical constraints of comprehensive economic sanctions. □

Contributors

B. O. Daponte conceived and carried out the analyses presented in this article. R. M. Garfield contributed to revisions of the analyses and the text. Both authors wrote the paper.

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